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ABSTRACT

The National Computing Centre Limited (NCC), established by the British Government to extend and improve the use of computers in the United Kingdom, is a major force in computer science education. As part of the overall national plan, training course packages consisting of lecturer's materials, visual aids and student notes have been prepared for audiences of computer professionals and for groups of users. For the former, a six-week basic course and shorter advanced courses in operations research, hardware and software updating, on-line systems, systems evaluation and business information systems have been developed for systems analysts. Also available are courses in data communications, computer management and first level programing. In the area of user education, courses have been designed for secondary school students and for business executives whose general responsibilities involve them with computer projects. All these materials have been used successfully, and thus the result of NCC's activity has been the creation and implementation of computer science training programs which are both educationally sound and grounded in practical experience. (PB)

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TOWARDS A NATIONAL PLAN IN APPLIED EDUCATION AND TRAINING

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by
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The United Kingdom computer market is increasing in size annually at a rate of between thirty and forty per cent. This growth rate is not peculiar to the United Kingdom, but presently the existence and influence of the NCC on computer education is a unique feature of the British computing scene.

The National Computing Centre Limited (NCC) was established by the Government as a non-profit distributing organization in June 1966. Its income comes partly from the Government, partly from the sale of its services and products, or from membership fees. These members represent computer manufacturers, consultants, users (Government departments, local authorities, and private firms), and account for some sixty per cent of the country's computing power. This unusual constitution enables NCC to act as a link between Government, industry and commerce. The objectives of the NCC can be paraphrased as being to extend and improve the use of computers in the United Kingdom. This is achieved through co-ordinating existing activities, acting as initiator and catalyst in the development of new techniques, disseminating information and the best practices and procedures and by providing advice, information and educational services. Even now, November 1973, it is still a comparatively small organization employing about two hundred including secretarial staff, but because of its impartial and unique position it has a significant influence on business, commerce and industry in the U.K. and is beginning to have an impact on Europe. From the NCC's inception, education has been recognized as being of prime importance, and this paper describes some of this work, both in the training of computer professionals and the education of computer users.

Systems Analysis Training

In June 1967, a working party representing computer users, computer manufacturers and educational experts produced its report.* This pointed to a considerable shortfall in the supply of systems analysts, and proposed that a national plan for systems analysis training should be established in the U.K. The NCC was asked to convert this national plan into a reality.

* Systems Analysis & Design Working Party Report (NCC)

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Diagrammatically the plan took the following form:

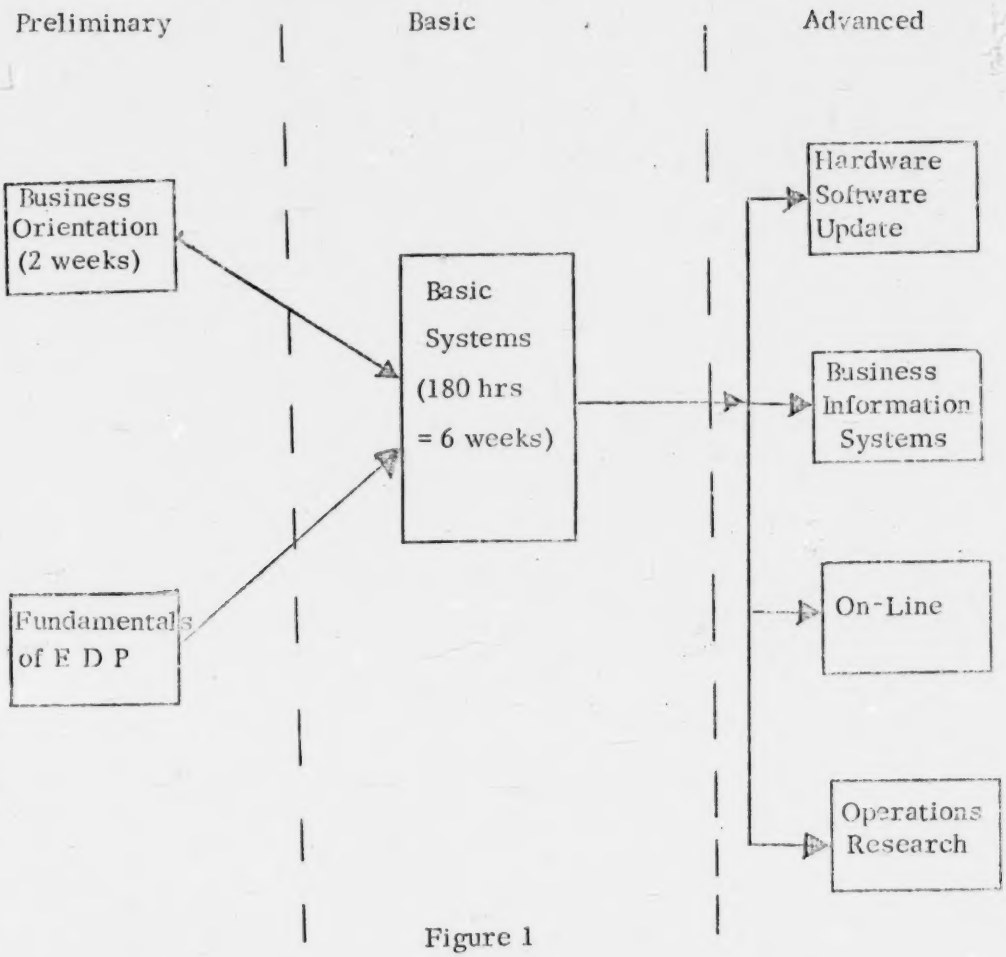

Figure 1

The method used successfully in implementing this scheme and indeed all our subsequent educational work was the creation of packaged courses. A package normally consists of -

1 Lecturer's Guide which provides:

- A general guide to the course including its objectives, a typical timetable and general notes on the material and course

and then for each session

- Presenter, characteristics and experience of an 'ideal' presenter
- Session objectives
- Recommended teaching method
- Materials i.e. supplies and equipment

- Summary of Lecture giving main parts to be covered, keying in appropriate visuals, and giving guidance to the time which should be spent on individual parts
- Lecture Notes. A complete narrative covering the subject matter. Where exercises are involved, complete solutions are included.

2 Visuals - in the form of overhead transparencies

Films - currently for the Basic Concepts Package only

3 Student Notes for each session

- Objectives
- Subject matter
- Copies of all visuals

A package attempts to eliminate the considerable development necessary in any course, while at the same time bringing together the latest practical developments and the best teaching techniques. It has been seen that an experienced teacher with the necessary practical experience can use a package to present an integrated and tested course with the minimum of preparation.

The first package produced and tested by NCC was for the basic training of systems analysts. It was anticipated that this would sell only in the U. K. and that the total market was likely to be about thirty packages.

In fact, this proved to be a considerable underestimate of the U. K. market, and failed to recognise the very large potential that exists overseas. The first edition of the package appeared in November 1967 and was quickly taken up, and replaced by an up-dated and more sophisticated version in January 1969. In October 1971 the third edition was produced and is still current. To date the basic package is being used by over one hundred organisations in the U. K., and more than one hundred are in use in some thirty countries overseas. The interest that has been aroused in the development has been world wide and has been shown at the various international computer conferences and exhibitions which have been attended by NCC staff.

The users within U. K. fall into two categories, namely Colleges and Industry, including computer manufacturers. The original conception was of a six-week full-time course of 180 hours, but in practice the course is now run in many guises on a full and part-time basis. Overseas, the users are either in education or industry and include such international agencies as the International Labour Organization. The material has already been translated into French, German, Spanish and Japanese, etc.

As soon as the basic course had been created, steps were taken to develop the other elements of the national plan. Representative working parties consisting of members of industry, education and NCC were again set up to develop syllabuses

covering the preliminary modules and two packages covering Business Orientation and the Fundamentals of EDP were the result. These packages were designed to answer the need for computer staff who lacked business experience or systems staff who were lacking in computing knowledge. As for the basic systems analysis package, this material was developed and tested and offered either to technical colleges or to firms for the training of their junior analysts and is not normally taught by NCC staff.

Whilst starting the development of the specialized courses, it was found necessary to add to the national plan. The basic course for the training of systems analysts was aimed at the trainee systems analysts with some business and computing experience. In practice a number of systems analysts were already active and relatively experienced who had not had the benefit of any coherent training. It was therefore decided to develop a four-week course in systems analysis and design aimed at this type of analyst. Our original intention was for NCC to run the course for one series only of three courses and to draw students from our membership organisations. In fact fifteen courses for some 200 students were successfully organised before the course structure was completely revised.

This version was felt to be necessary because of the changes in the student population. Initially it had been necessary to deal with essential educational material even revising basic hardware and software, but during successive course series the level of expertise has risen noticeably so this type of session was no longer relevant. By removing the now redundant sessions, and by making the duration two rather than four weeks the course has received a new lease of life, and is now at the beginning of yet another series.

The final stage of the original national plan was the creation of the specialised course modules. These cover -

Operational research
Hardware & Software updating
On-line systems
Systems Evaluation
Business Information Systems

With the exception of Business Information Systems, they are scheduled to last one week. The B.I.S. is a two week course. These courses are run either by NCC or the Colleges.

A more recent development has been the amalgamation of much of the material from the individual modules into the four week Professional Development for Systems Analysts. This course is aimed at the senior analyst and is designed to broaden his knowledge of the business environment and to emphasise the role of systems work in this environment. It includes the study of systems methodology in greater depth than can be done on the basic course, detailed consideration of data base organisation and management, systems evaluation and an introduction to the use of O.R. techniques. Currently this is being run by NCC consultancy staff.

Yet another development has been a Data Communications system course organised jointly with the Post Office. The Post Office has considerable expertise in the field of data transmission and indeed has prime responsibility in the U. K. for data communication systems. The course is intended for senior data processing specialists who are involved or may become involved in the evaluation, design and implementation of commercial data communication systems. It sets out to provide a detailed explanation of the techniques, services and equipment used for transmitting data, and a knowledge of the factors to be considered in the design of on-line systems.

Both the basic and the specialised courses are the basis of nationally recognised examinations and certificates which are organized in co-operation with the British Computer Society. The British Computer Society which is the professional organization of computing specialists in the U. K. has worked with the NCC in establishing a certificate award at both the Basic and Higher Levels for Systems Analysts. The basic course is now completely established and some 4,000 students have been awarded the Basic Certificate. The Higher Certificate is slowly beginning to gather impetus and the Professional Development of Systems Analysts course has been specifically developed to assist students to pass the Higher Certificate.

At present the Higher Certificate gives limited exemptions from the British Computer Society's examinations. Negotiations are currently taking place to extend the range of exemptions and to introduce certification at the end of the two weeks systems analysis and design course. The basic certificate is also now awarded in some other countries under arrangements by the NCC and ECS. The certificate gives some recognition of a student's achievement, in that he is examined by both internal and external examiners, and in addition to a written paper is assessed as to the personality and must pass a severe viva voca. Furthermore, the activities of the external examining panel go some way towards the establishment of a National Standard of course presentation.

Documentation Standards

In keeping with its role as an initiator and catalyst, the NCC has produced systems documentation standards. The standards were originally produced in 1969 and were a product of co-operation between NCC and its members, and the distillation of the best of other standards.* The standards are designed for use in any commercial data processing activity irrespective of application area or machine used. They are structured in such a way that local variations and house rules can be added.

Any good documentation must aid analysis, design, control, completeness, communication and training. Our acceptance of this fact is shown by the place standards training now takes in the training of Systems Analysts. We have developed courses to teach the standards, and the standards are now an essential feature of all courses.

* Systems documentation Manual (NCC)

A system documented (NCC)

Documenting systems - the user's view (NCC)

The complete picture of NCC's developments in the training of Systems Analysts is shown in Figure 2. This illustrates how the situation has changed since the original Statement plan was developed.

A comprehensive training plan for systems analysts

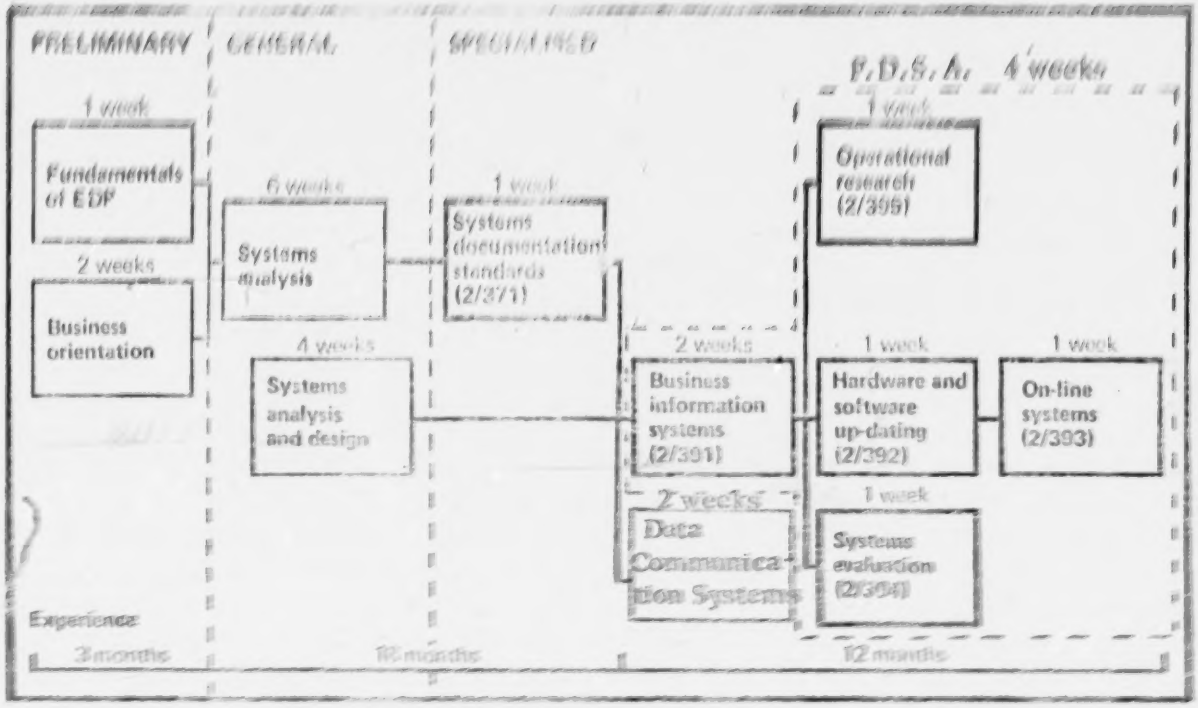

Figure 2

Management of the Computer Professional

In 1969 attention was focussed on Data Processing Management training. A report was produced in 1970* which identified the problem areas, the skills required, and recommended ways of solving the problems.

The original course plan was for a series of six courses lasting up to 10 days. In practice, it was discovered that three courses each lasting four days met the majority of requirements, and were acceptable to potential course members. This situation highlights a practical problem in any course development i.e. the problems of reconciling the ideal length and content of courses, with the external pressures imposed on potential course members to complete their education in the minimum time.

The three courses which have been produced are:-

A Computer Personnel Management This deals with the human problems inherent in Data Processing and is suitable for those with responsibility for organising and controlling staff.

* Management of Computer-based data processing (NCC)

B *Planning and control of Systems Projects. This provides guidance and techniques for planning and controlling systems projects and resources and is suitable for those having supervisory responsibility in Systems, Programming or Project Teams, or who are being prepared for such responsibility.*

C *Planning and control of operations resources. This provides guidance and techniques for planning operations, resources and facilities and controlling the day to day running of an operations department. It is suitable for those having supervisory responsibility in a computer operations department or who are being prepared for such responsibility.*

It is recommended that those wishing to have complete systems development management training take Modules A and B consecutively while operations could take Modules B & C.

First level programming

The most recent development in professional training is the development of a programming course.

This material is designed in four modules viz.:

Module 1 Fundamentals of E.D.P. This is the current edition of the course originally produced as part of the National Plan for the training of Systems Analysts

Module 2 Programming concepts and techniques - Not machine dependent

Module 3 ASSI COBOL - taught as a universal high level language

Module 4 COBOL Project - consolidating the techniques and language by writing, testing and documenting a suite of programs.

The total duration of all modules taken together is 6 weeks though it is anticipated that there may well be breaks bwteeen the individual modules to allow for practical experience.

The material which is in the final stages of preparation, deviates somewhat from the normal package format. Each session suggests a presenter's profile, method of presentation, and in the case of modules 1 and 4, lecturer's notes as a complete script with hard copy visuals. In Modules 2 and 3, lecture summaries with timings plus hard copy visuals with references are keyed in.

Student Notes are available for Modules 1 and 4

Modules 2 and 3 require that the lecturer recommends an appropriate text book. For Module 2 a text book will be available from NCC in Spring 1974, and for Module 3 the student is advised to use the appropriate manufacturers COBOL manuals or the NCC Publication Fundamentals of COBOL.

The material has been produced so that the colleges who will normally run this course, will be preparing the students for City and Guilds qualifications. Currently the Home Office Prisons Department are using the material for the education and rehabilitation of selected prisoners.

Other Education

Schools Education

Early in 1968, NCC decided to establish some form of data processing education in secondary schools. Plans were drawn up and implemented which led to the development of a package that can be used by the teachers of sixth formers (i.e. 16/18 age group) at school. The title of this package is "Computing - Its Impact on Business and Society" and the title aptly describes its objectives. In the U.K. there are approximately 6500 secondary schools. As a consequence of its unique constitution, the NCC has been able to approach the problem simply from the viewpoint of national interest. Through the co-operation of schools, Local Education Authorities, member firms (including manufacturers) and Government Departments, NCC has developed and tested its scheme for extending computer education in schools. A package has been produced which is available to the schools at minimum cost. This is only possible because NCC is not a completely profit-oriented organization and cash which is earned in other areas can be used in schemes like school education. (Indeed by law we cannot distribute profits). So far the package is being used by schools and it is hoped to increase this number to cover all the secondary schools in the U.K. within the next ten years. Once again considerable interest has been created overseas regarding the possibility of the use of this package.

The sixth form package was designed for students of above average ability and NCC was quick to realise the need to give students of lesser ability an appreciation of computers in modern society. Assisted by educationists, NCC produced guidelines to be used by any teacher regardless of discipline. The guidelines can be used in an actual computer course or as a module within a different course such as the humanities, environmental studies, or perhaps mathematics.

The guideines are in the form of a comprehensive set of teacher's notes and also contain full details of appropriate supporting materials. These include a set of pre-cut spirit duplicating masters which are used to produce cheap student handouts. References are also made to films, slides, books, articles and organisations that will be able to help the teacher in establishing the course.

This approach has proved to be even more successful than the 6th form package, and is now being used in schools for all types of pupil. An important feature has been that teachers of many subjects have used the material with very good effect, e.g. computer science, mathematics, remedial, physical education and English.

During our work in preparing support material for schools it became evident that there was a major need for suitable visual and support. The result was the schools visual project film package. Several commercial films were edited, a limited amount of new film was shot and eight short concepts films were produced. A ninth film produced by Barclays Bank was also added. Ten sets of teaching notes are provided with each film package. The notes give in all cases a synopsis of the film and where appropriate, a possible line of further development is indicated by a series of work cards. The material is not a complete course in itself merely it is supporting material for existing courses.

A Student's Cobol package has been produced to help schools and colleges who wish to introduce a greater element of data processing into computer courses. Aimed at the 15-19 age group it teaches a subset of Cobol - and gives the student a balanced view of data processing topics. By using pre-punched cards the problem of data preparation is virtually eliminated, and the student can prepare a complete service deck ready for processing except for about five cards that are dependent on the installation.

As yet another service NCC has again co-operated with the British Computer Society in publishing a guide to computers and careers called "Working with Computers."

Management Education

Since 1968, NCC has been very much involved in the education of user management. This stems from the very firmly held belief that the success or failure of any computer installation depends upon the involvement and commitment of user management, and that the computer exists to serve the organisation.

Our first major contribution in this field began in collaboration with the Engineering Industry Training Board. The EITB was set up under the Industrial Training Act of 1964 which had the main objective of providing an increase in trained manpower to improve training standards and to achieve a fair distribution of training costs. The Training Board of which there are now twenty-nine, have the power to establish a training levy which is collected from employers, and to determine how their training grant system should operate.

In December 1968, NCC was asked by EITB to convert the proposals of a joint committee representing training boards of computer manufacturers and further education into a practicable series of courses. The result was the creation of a:

one-day course for Chief Executives
three-day course for Functional Directors
five-day course for Senior Managers

The last two courses were fully residential.

The basic objectives of these courses were:

1. to dispel the mystique associated with computer equipment and staffing

2. to define the role and degree of involvement of all levels of management in the planning and control of computer projects.

3. to emphasize the importance of training and education for both computer and departmental staff

The emphasis throughout is on the importance of management's contribution and the need to exercise very strict project control over the introduction or extension of computer usage (see figure 3).

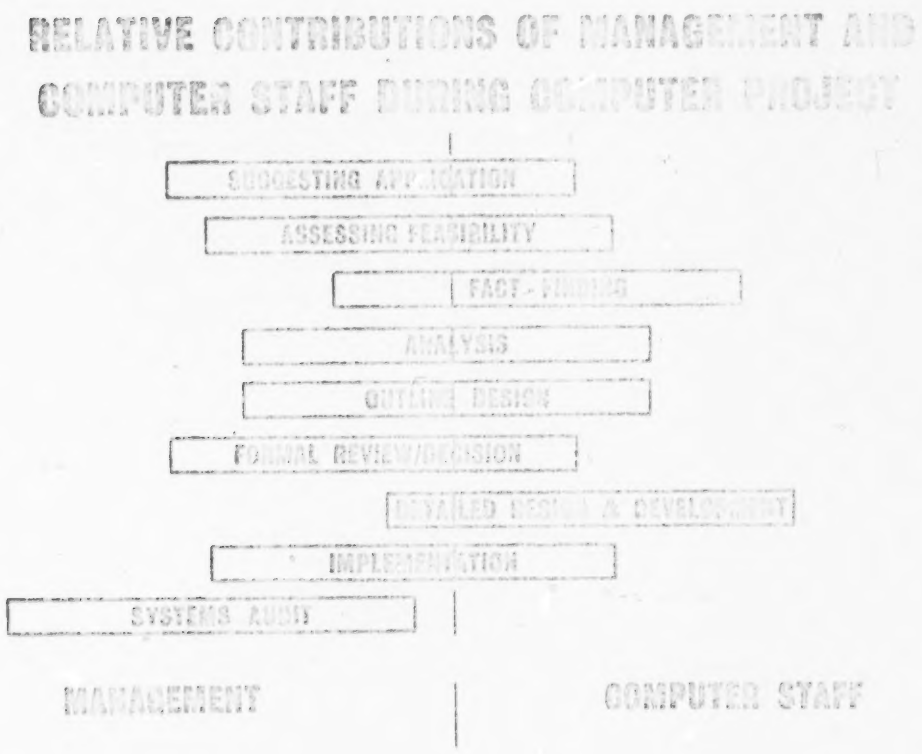

Figure 3

The success of these courses is very apparent. There have been many examples of members of the same company attending successive courses, and as a result of the co-operation with EITB, in-company courses have subsequently developed. A total of 55 courses for some 800 directors and senior managers were organised with the Training Board and to-date approximately 80 organisations have used our expertise in mounting in house courses. The in-house business has proved particularly important since in some cases we have been asked to run as many as 10 courses for a single company.

Using the experience gained in the training of Systems Analysts, the Functional Director and Senior Management material was packaged. It was after this stage that our approach to courses changed quite radically. Initially, we regarded our material as consisting of self contained courses. We very quickly realised that particularly in the in-house environment there might well be limitations as to time, and requirements peculiar to particular organisation. We therefore developed the concepts of modern material which is described later.

Our first efforts were directed towards the medium to large organisation, but we were constantly aware of the needs of the smaller company. Once again, the Engineering Industry Training Board provided invaluable support. Many of the firms in the engineering industry are of small to medium size i.e. 20-400 employees. Increasingly these organisations are anxious to know what computing facilities are available, and what criteria should be used for selection. NCC therefore developed a two day course, "Computers for the Smaller Company." The E.I.T.B. commissioned us to run a series under their sponsorship. We are currently involved in running these courses which take place during the week-end. The duration and timing of these courses i.e. Saturday and Sunday has been designed to meet the requirements of the small organisation. The large organisation can spare one or even two executives for short periods. In the small firm one or two might be the only managers so that they are truly indispensable during the working week.

The series is proving very successful and obviously has a large potential. There is also a demand for its application on an in-company basis in the medium sized organisations.

This in-company or "in house" course has developed into one of our most important activities. To date, nearly one hundred organisations covering the whole spectrum of British industry have used NCC consultancy staff to run many different types of computer course. The courses have covered almost all areas of professional training and user education and now account for more than 50% of our course running activities when related to the number of Student weeks involved.

Modular Material

Perhaps the most essential feature of this technique is the application of strict standards in preparing course material. The package format described at the beginning of the paper is followed and even the layout of typescript and typeface to be used must be strictly specified. A major problem is existing material which must meet the new standards. This is a problem which we are gradually overcoming.

The result of this approach is that we can now produce 'tailor made' courses from standard material. This apparent contradiction is explained by our ability to merge sessions from different courses to produce the required mix. This approach considerably reduces the development cost to the client, and optimises the use of our efforts. There are still of course some examples of completely unique requirements which require special development, but these

are kept to a minimum.

Short non-residential courses

Our most recent developments have resulted in the preparation of short duration non-residential courses that concentrate on particular subjects. The courses which normally last one or two days are aimed at:

Technical Appreciation
Control Aids
Programmer Aids
Systems Analyst Aids
Business Systems Appreciation

This new approach is a reflection of the changing needs of computer users in U. K., and NCC's efforts to meet these changes.

Results Within the United Kingdom

The result of this activity in the UK has been the creation of schemes of computer education which are based on sound practical principles. The NCC fulfils a unique rôle and is able to produce courses and material which are sound educationally and yet are based upon practical experience, through the co-operation of its members both industrial and academic. It has proved possible to produce packages which can train systems analysts, give managers a basic appreciation and yet be used by competent teachers in industry and colleges. It is not claimed that this is the only solution of the problem of computer education, but it is a solution which produces almost immediate and very valuable results by the efficient use of limited resources.